SAFEGUARDING FOOD SECURITY IN VOLATILE GLOBAL MARKETS

EDITED BY
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Contents

Chapter 12

The fallacy of price interventions: a note on price bands and managed tariffs

Brian Wright and Adam Prakash[1]

In the last century, a large variety of policy interventions have been used to address problems associated with price volatility in markets for storable commodities, notably grains. These include controls or sanctions on private "hoarding" or "speculation", buffer stocks, buffer funds, strategic reserves, use of options and futures, rationing of low-priced supplies, marketing boards, price floors, all of which obviously affect market incentives.

To interpret the asymmetric and episodic behaviour of grain market prices, and identify the causes of high volatility, it is crucial to understand the relation between prices, consumption and stocks (see Box 12.2). Accumulation of stocks when price is low can prevent steep price slumps. Disposal of these stocks when price is higher can smooth price spikes, but only if stocks are available. In a competitive market, short hedgers perform these functions, holding carryover stocks when the expected price covers the cost of storage and interest. Futures markets encourage short hedgers by facilitating the transfer of price risk to long hedgers (such as grain users) or long speculators, and protecting all participants from counterparty risk.

In the long view, recent grain price volatility is not anomalous. Wheat, rice and maize are highly substitutable in the global market for calories, and when aggregate stocks decline to minimal feasible levels, prices become highly sensitive to small shocks, consistent with storage models. In this decade stocks declined due to high income growth and biofuels mandates. To protect vulnerable consumers, countries intervened in storage markets and, if exporters, to limit trade access. Recognizing these realities, vulnerable countries are building strategic reserves. The associated expense and negative incentive effects can be controlled if reserves have quantitative targets related to consumption needs of the most vulnerable, with distribution to the latter only in severe emergencies. More ambitious plans to manipulate world prices via buffer stocks or naked short speculation have been proposed, to keep prices consistent with fundamentals. Past interventions of either kind have been expensive, ineffective, and generally short-lived.

The failure of commitment to uninterrupted market access among grain exporters (especially in the rice market) has also highlighted the desirability of commitment-reinforcing mechanisms for international grain market participants.

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Box 12.1: The economics of storage activity

To interpret the behaviour of grain market prices, and identify the causes of high volatility, it is crucial to understand the relation between prices and stocks. For the market to function effectively, a virtually irreducible minimum amount of grain must be held in the system to transport, market, and process grains. Though stocks data are notoriously imprecise, minimum working stocks are widely thought to be around close to 20 percent of use. A common feature of all such physical storage activity is that aggregate stocks are constrained to be non-negative. If current stocks are zero, it is impossible to "borrow from the future". To begin, assume that one crop is sown annually. The harvest in year t, h_t, is random, due to weather and other unpredictable disturbances. The effects of storage on consumption and price of grains, illustrated in the figure, is the result of the horizontal addition of two demands. One is the demand for consumption in the current period, c_t; the other is the demand for grain stocks in excess of essential working levels, x_t, to carry forward for later consumption. Consumption responds to price according to the downward-sloped function $P(c_t)$. Stocks x_t cannot be negative. To keep things simple, we ignore deterioration. In any period, regardless of the economic setting (monopoly, competition, state control of resource allocations) two accounting relations hold. The first defines available supply A_t is the sum of the harvest and stocks carried in from the previous year:

$$A_t = h_t + x_{t-1}$$

The second states that consumption is the difference between available supply and the stocks carried out:

$$c_t = A_t - x_t$$

Assuming competitive storage, stocks x_t are positive (in excess of minimal working stock levels) only if the expected returns cover costs (competition between storers prevents them from making greater profits). This means that the current price of a unit stored must be expected to rise at a rate that covers the cost of storage k and the interest charge at rate r on the value of the unit stored. Given available supply, A_t, storers carry stocks x_t from year t to year $t+1$ following a version of the age-old counsel to "buy low, sell high" represented by the competitive "arbitrage conditions":

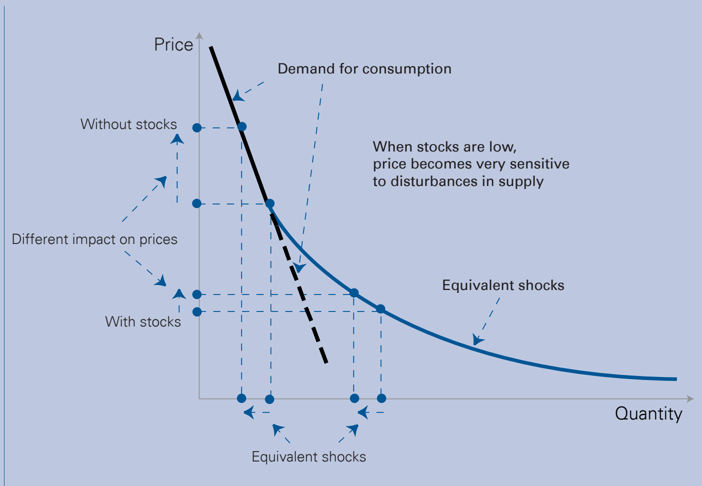
$$\begin{aligned} P(A_t - x_t) + k &= \tfrac{1}{1+r} E_t\Big[P\Big(x_t + \tilde{h}_{t+1} - \tilde{x}_{t+1}\Big)\Big], \qquad if \quad x_t > 0 \\ P(A_t - x_t) + k &\geq \tfrac{1}{1+r} E_t\Big[P\Big(x_t + \tilde{h}_{t+1} - \tilde{x}_{t+1}\Big)\Big], \qquad if \quad x_t = 0 \end{aligned}$$

where E_t denotes the expectation conditional on information available in year t, and $\tilde{h}$ and $\tilde{x}$ are random variables. As shown in the figure, when price is high and stocks (excluding essential minimal levels) are zero, the market demand is the same as the consumption demand.

Those who consume grains such as rice, wheat, or maize as their staple foods are willing to give up other expenditures (including health and education) to continue to eat their grain, so the consumption demand is very steep and unresponsive to price ("inelastic"); large changes in price are needed if consumption must adjust to the full impact of a supply shock unmoderated by adjustment in stocks. In 1972-74, for example, a reduction in world wheat production of less than 2 percent at a time when stocks were almost negligible caused the annual price to more than double. The figure also shows how, when stocks are clearly above minimum working stocks, storage demand, added horizontally to consumption demand, makes market demand much more elastic (less steeply sloped) at a given price. The responsiveness of this aggregate consumption demand to price is difficult to estimate, for several reasons. One is that, in empirical demand studies at the level of the individual consumer, it is difficult to distinguish consumption from storage (including stocks held by consumers) as prices fluctuate, and when the two get confounded the estimated response overstates the consumption response.

Secondly, at the aggregate level, years with high prices and negligible stocks above working levels are too rare to establish, by themselves, the steepness of the consumption demand.

Figure 12.1 How stocks moderate price response to shocks



Estimation of the dynamic storage model enables us to use data from all available years in determining consumption demand. However, the storage model has been difficult to implement empirically. One major hurdle is, again, the lack of reliable stock (or consumption) data (in recognition of this, grain statistics refer to "disappearance" rather than consumption). Work that pioneered the econometric estimation of this model in the 1990s, assuming no supply response, finessed the data problem by estimating the model on prices alone (see Deaton & Laroque, 1992; Deaton & Laroque, 1995; and Deaton & Laroque, 1996).

Recent application of a model in this tradition to prices of a set of commodities suggests that aggregate food-consumption demand responds very little to changes in the price of major commodities; the slope of the consumption demand curve for major grains may be even steeper than previously believed (see Chapter 15). To compensate for the low price response of consumption, more of the commodity is stored and stocks run out less frequently. The storage implied by the model smoothes prices, replicating the kind of price behaviour observed for major commodities.

By acquiring stocks when consumption is rising and price is falling, storers can reduce the dispersion of price and prevent steeper price slumps. Disposal of stocks when supplies become scarcer reduces the severity of price spikes. If the supply of speculative capital is sufficient, storage can eliminate negative price spikes but can smooth positive spikes only as long as stocks are available. When stocks run out, aggregate use must match a virtually fixed supply in the short run. Less grain goes to feed animals and the poorest consumers reduce their calorie consumption, incurring the costs of malnutrition, hunger or even death.

Storage induces positive correlation in prices and is least effective when harvests are positively correlated; storage cannot eliminate price changes caused by persistent shifts in demand such as the recent subsidized surge in biofuel production. Note also that the storage demand shown in the figure would shift up, pulling total demand with it, if the supply variance rose or interest costs fell.

If producers can respond to incentives with a one-year lag, that response is highly stabilizing for consumption and price. Their competitive adjustments of planned production increase the effectiveness of adjustments of stocks in smoothing consumption and price. When supplies are large, for example, returns are low and producers cut back production in response to lower returns and hold more stocks.

One such mechanism, discussed in the previous chapter - an "international coordinated global food reserve" - is included as the second part of the proposal by the International Food Policy Research Institute (IFPRI)[2]. The proposal is sketched as an agreement by members of a "Club" including members of the G8+5, plus major grain exporters such as Argentina, Thailand and Viet Nam. The members would commit to holding specified amounts of public reserves in addition to the reserves held by the private sector. These would be used to intervene in the spot market as directed by a "high level technical commission" appointed by the Club on a permanent basis, with full decision-making authority. Operation of this reserve is to be coordinated with operation of a virtual reserve, the third element of the proposal of IFPRI.

The interventions of the international reserve and the virtual reserve are apparently designed to execute a dynamic price band system operated by a "global intelligence unit" which also makes market forecasts and determines when markets are not functioning well. This unit would be part of an institution that "already has the long-and medium-term modeling infrastructure for price forecasting."

One difficulty in assessing this proposal is its lack of clarity in defining the problem it is meant to solve. Apparently these include "excess price surges caused by hoarding and speculation", restoring confidence in the market, preventing ad hoc trade policy interventions, and allowing the market to guide resource allocation in response to fundamental changes in supply, demand and production costs. A win-win solution is anticipated for producers and consumers, exporters and importers.

In assessing a price-band proposal and other market problems and interventions to be addressed, it is helpful to keep the following points in mind:

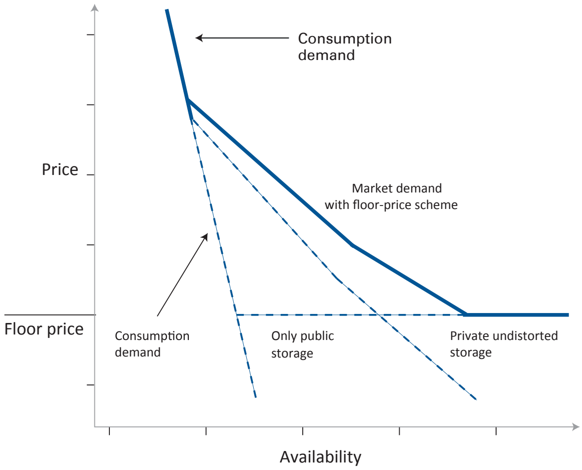
1. Any activity or policy that does not change consumption in a market does not affect prices in that market. On the other hand, if a policy decreases price, it increases consumption and decreases stocks. If planned production is responsive, it also decreases when the price drops.
2. Unless they address the fundamental source of disturbance (for example, disease, war, or weather), "stabilization" policies must actually destabilize some key variables (stocks or public budgets, for example) as they stabilize others (such as price).
3. There is no evidence that any chosen group of experts, no matter how well qualified and motivated, can reliably determine when a competitive market is acting in a way not justified by fundamentals. Indeed, the evidence against the general proposition that designated experts can outperform the market in forecasting or trading has grown overwhelmingly in the last several decades. Certainly the major international organizations concerned with food markets for the poor have no record of demonstrating such performance and wisely make no assertions of the capacity to do so.
4. In any intervention, net efficiency gains to the society as a whole are typically dwarfed by redistribution of gains and losses between producers and consumers. Those who most enthusiastically and effectively support storage interventions naturally tend to be the ones who are expected to gain from those policies. To comprehend these distributional effects, it is necessary to recognize the dynamic nature of the problem and also the importance of private responses to public actions.

A simple public floor price programme

Policy-makers find price-band policies appealing because they seem simple and easy to explain. The claim that the band keeps prices stable and concentrated around the centre of the band is intuitively appealing. Unfortunately, it is also misleading. To see why, it is best

[2] See von Braun et al. (2009) and von Braun & Torero (2009).

Figure 12.2: The effect of a price floor on market demand



to consider first a simpler version consisting of a price floor at which the manager makes an open offer to buy or, subject to availability, to sell any amount of the grain in question.

Consider, for example, the announcement and introduction of a public floor price programme in a market with no short or long run production response and a random harvest. If the initial price is below the floor price p^F, the immediate effect is to increase price and stocks, draw down government funds, and reduce consumption. If the initial price is above p^F, and no private storage is allowed, the effects of introduction of the floor price p^F on storage, price, government funds and consumption are delayed until a there is a harvest large enough to push price below p^F if it were all consumed.[3] In the long run there is a significant probability that price is at the floor. Whenever the programme holds has stocks, the price stays at the floor, but when stocks are exhausted the price rises above the floor, and subsequently it reflects the outcome of the most recent harvest.

If, on the other hand, there is competitive private storage, and price is not too far above p^F, the introduction of the price floor raises the price higher immediately and reduces consumption, as the existence of the floor raises the expected price and encourages more private storage, increasing total demand, as illustrated in Figure 12.2. Government expenditure is delayed, however, until the price falls to p^F, and remaining stocks are sold out to the government.

In each of the above cases, the earliest non-zero effects of the price floor scheme on commodity price must be positive, as the first public purchases must precede the first public sales. This means that producer revenues are increased by the early effects of the programme as stocks are accumulated. The effects will be reversed later, when stocks are released, but the time value of money means the earlier gains to producers tend to dominate the later losses.[4] If land is priced to reflect the profits that it can produce, land price jumps when the programme is introduced, even if the effects on commodity price are delayed.

3 If there is supply response, then consumption and price, but not government revenue, are affected before the floor price is reached.

4 To see this, consider that the early gains could be invested and earn interest before they are balanced by equal dollar outflows. (See Wright, 1979 and Williams & Wright, 1991 for more on distributional effects of market stabilization.)

If private inventory holders are allowed to co-exist with the public programme, the floor is less frequently in effect, so in this sense the price is less stable. But such price variation, when it occurs, is dampened by the action of private speculators, and in this sense the market is more stable, and public and private stocks are complements in stabilizing the market.[5]

Price band buffer stock programmes

The floor price scheme described above is pedagogically useful for its simplicity. International agreements involving commodities including rubber, cocoa and tin have often combined the floor price with a higher “ceiling” or “release” price, a plausible way to protect consumers from the most extreme effects of price spikes. One consistent policy prescription in the history of economic advice on commodity markets has been that prices should be stabilized in a symmetric band around the mean, bounded by the floor and ceiling prices, to reduce the "boom and bust" gyrations typical of commodity prices (Keynes, 1982 and Newbery & Stiglitz, 1982).

A strong intuition is that such a programme keeps price around the middle of the “price band” most of the time, if the band is judiciously chosen. But numerical examples show this is not true.[6]

As illustrated in the Figure 12.3, for a programme with a floor that is 87.5 percent of the mean price of USD 100, and a ceiling set at 112.5 percent, there is a probability of about 15 percent that price is at the floor, and the probability that price is at the ceiling is almost 30 percent. There is little probability that price is between the mid-point of the band and the top. Most of the time, the market appears to be “challenging” either the floor or the release price.

The price ceiling discourages production and storage when available supplies are scarce, increasing price volatility as price approaches the ceiling. Are consumers willing to submit to a high probability of price at the ceiling, in exchange for reduction in frequency of greater food emergencies that may occur less than once in a generation?

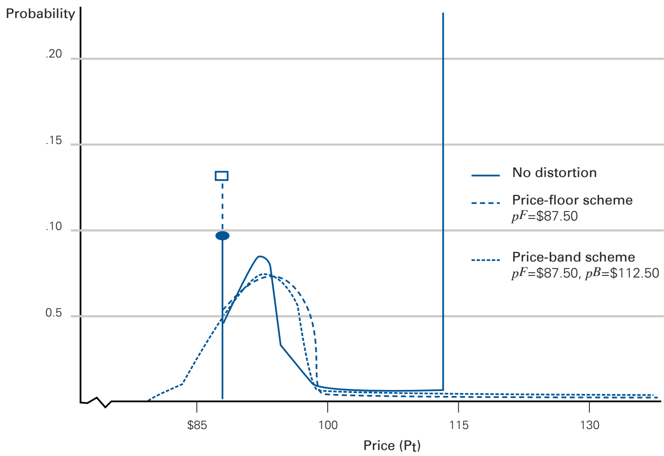
Another serious consideration is whether the sacrifice in terms of more frequent high-price years will be repaid with smoothing of extreme peaks when they occur. When a programme chooses a price floor p^F no higher than the free-market mean (adjusted for a perfectly-estimated trend if necessary), or chooses a price band where the mean of a floor and ceiling price equals the free-market mean, the programme has commonly been assumed to be “self-liquidating,” that is, financially sustainable based on the fact that expected net balances should equal zero, and on the intuition that the summed funds from purchases and sales after several years of operation should be close to their initial value. But this intuition is wide of the mark, even for a simple floor price scheme.[7]

5 From the programme administrator’s perspective, private speculators are the culprits in sporadic “speculative attacks” on the public stockpile: they acquire the whole stock when the price rises above the floor, and dump their stocks on the government programme when the price reverts to the floor. These actions may be viewed as “destabilizing” the stockpile, but they reduce large changes in price and consumption. (See Williams & Wright, 1991, Chapter 13.)

6 There are important interactions between bandwidth, private storage within the band, supply response, the expected rate of accumulation of losses, and the maximum level of stocks. See Williams & Wright (1991, Chapter 14).

7 To see this, consider the simple case in which demand is linear and planned production is constant, so the mean price is exogenous. Assume further that the harvest has a symmetric two-point distribution, there is no private storage, and p^F is set at mean price, the price when consumption equals mean production. Imagine

Figure 12.3: Price probabilities under a price floor and a price band

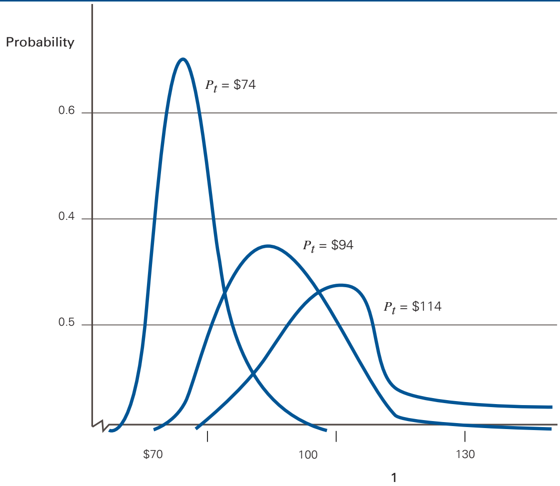


After several decades of operation (less than the interval between the last two extreme price spikes) the likelihood of a balance close to zero becomes vanishingly small. The fund may accumulate great profits along the way, appearing to affirm managers' skill and inducing pressure to raise the floor. Even if such pressures are resisted, the balance will deplete any operating reserve in finite time. In practice, post-war experience has affirmed that the "finite time" within which we expect such programmes to fail is disconcertingly short, often less than a decade. Recent failures in programmes for tin and wool (Bardsley, 1994; Gilbert, 1996; Haszler, 1988), among others, have shown that the largest and most catastrophic price effect of these interventions is the severe price collapse that accompanies their inevitable failure.

When such price support programmes do fail there is generally a public consensus that the intervention price was wrongly set, and management is often blamed for faulty trend forecasting. There is scant recognition that failure is inevitable at any relevant intervention price. Higher floor prices merely hasten its occurrence, and price band programmes tend to fail much faster because they tend to accumulate stocks at a faster rate. One way to try to avoid such failure might be to modify a price floor rule so the floor is adjusted down somewhat after one or two years of low price. This will enhance sustainability by reducing accumulation of debt. Figure 12.4 shows three probability densities of prices conditional on current prices respectively 74 percent, 94 percent and 114 percent of the mean, generated by a numerical model of competitive storage. If price is 94 percent of the mean, there is virtually no chance it will be below 70 percent of the mean next year. If the price does fall to 70 percent of the mean, there is virtually no chance it will fall below 60 percent next year. The market is acting like a floor price programme with floor price adjusting for recent experience, to prevent excess losses.

a "buffer fund" scheme whereby the government pays $p^F - p_t$ for each unit sold at each time t. Negative payments are receipts by the government. The fund's monetary balance, B_t, with initial value B_0, follows a random walk. Given an infinite horizon, the balance passes any finite negative bound in finite time, and the probability that it is zero at any future date is the same as the probability that it is never zero before that date, and quickly becomes negligible (see Feller, 1967, Lemma 1, p. 76). Similarly, a price floor backed by a buffer

Figure 12.4: Probability of price in period $t+1$ when current price P_t is 74 percent, 94 percent or 114 percent of the mean price, US Dollar 100



Note also that if price is 114 percent of the mean, the figure indicates a much larger chance of a lower than a higher price next year. There is a modest right tail indicating the probability of a price least 14 percent above the mean, but the model is acting much like an imperfectly effective price band programme with a ceiling at 114 percent of mean price.

Price band schemes, in theory, are bound to fail if the bands are not adjusted to reduce losses. In practice, failure comes fairly quickly. If, on the other hand, bands are adjusted to reduce accumulation of losses, the programme tends to mimic what the free market can provide. Price band schemes have been found wanting in theory and practice, and should not be tried again.

Using banded tariff regimes to manage global price volatility

In the 2006-08 episode, variable import tariffs were often employed by food-importing developing countries as a policy instrument, principally over the short term, to shield households from global food market volatility. As with all forms of price intervention, the challenge was and is to administer the level of tariff that allows price transmission in the long run from international markets to domestic markets which does not hinder the private sector's incentive to participate in international trade (World Bank, 2005).

Prior to the 2006-08 episode, variable tariff regimes were instituted in several Low-Income Food Deficit countries (LIFDCs) to mitigate the impacts of large falls in international prices, as applied tariffs could be raised up to bound commitments under the Uruguay Round Agreement on Agriculture (URAA).

Variable tariffs are also at the heart of "price band schemes". Price bands are a restricted form of variable levies, with the important distinction that they are not linked to a domestic support price (Valdes & Foster, 2003). They establish price floors and ceilings on import prices as a function of international reference prices.

stock generates a fund balance that hits zero with probability one in finite time (that is, "infinitely often"). If a price ceiling is added, the expected time is to a zero balance is shorter.

Box 12.2: Price band schemes and international trade rules

Price bands and their variants are used in Colombia, Ecuador, Peru and other countries, but Chile was the initiator of the price band model observed today. Although not exactly the same as standard variable levies, price bands themselves, however, are suspect. The 2002 WTO ruling in the case of Argentina's complaint against the Chilean price band for wheat products and edible oils held that the band mechanism was similar to a variable levy and a minimum import price, both of which were held in violation of the URAA. Interestingly, the price band led Chile occasionally to exceed its WTO-committed bound rates of 31.5 percent, but this complication was sidestepped when, after initiation of the complaint, Chile modified its price band formula so that any resulting tariff (regular plus price band surcharge) would not exceed the bound tariff level.

The WTO Appellate Body ruled that, although the price band is based on world prices, it "can still have the effect of impeding the transmission of international price developments to the domestic market." Although this transmission-impeding character of variable levies was the most questioned aspect, it was the combination of the transmission argument with the lack of transparency of the price band mechanism that was in violation: "[N]o one feature is determinative of whether a specific measure creates non transparent and unpredictable market access conditions. Nor does any particular feature of Chile's price band system, on its own, have the effect of disconnecting Chile's market from international price developments in a way that insulates Chile's market from the transmission of international prices, and prevents enhanced market access for imports of certain agricultural products."

In fact, Chile's price bands were originally designed to be very transparent, without changes in the determination of the external reference price. Under the original scheme, predictability would have been eliminated as a concern. But the question of price transmission is different, being inherent to the variable levy nature of any price floor scheme (whether or not it includes price ceilings). Furthermore, the ruling was unrelated to the country's generally low level of protection.

Source: Valdes & Foster (2003).

Under such schemes, when the import price falls below the floor, surcharges are applied, and when the price exceeds the ceiling, importers receive a tariff rebate up to the applied tariff.[8]

Price band schemes have been in operation for several decades in a few Latin American countries. However, they have raised questions over their legality under the WTO rules, as well as over their efficiency and transparency (see Box 12.2).

But under what range should tariffs be managed? Several possibilities for setting floor prices are often proposed: moving average and other trends, base-period average prices and a minimum average cost of the world's "most efficient exporter". The unsystematic nature of a base period price, despite its simplicity, does not incorporate long-term trends, and in the absence of updating, would divorce producer responses from long-run changes in international prices. With permanency in price shocks (i.e. non-stationarity or long-memory, see Chapter 2), historic moving averages and trends would incorporate long-run information but do not guarantee that future prices will stay on the historic trend. In addition, the smaller the order of the trend, the more sensitive would the trend to sharp price disturbances, which ultimately does not instil long-run price efficiency in domestic production. Finally, the proposal that the floor price should be set on the basis on the cost of production schedule of the "most efficient exporting country" is admirable in lessening the risks of stimulating

8 When applied tariffs are low, price bands have notably asymmetric effects on producers and consumers because surcharges are limited by the bound tariff (perhaps high) and rebates are limited by a low applied tariff.

domestic production among inefficient farmers, but at the same time raises the question of objectivity and arbitrariness in ascertaining lead-efficiency prices.

Conclusions

Attempts to manage volatility through price controls are proven theoretically and empirically to be less than optimal. Use of price band rules to operate international or domestic market stabilization schemes is less simple than often assumed and less effective in ensuring food security for those most at risk. The price tends to hover at or near the upper or lower band, private storage is reduced or eliminated, and production is discouraged just when it is most needed. Theory predicts, and experience confirms, that these programmes inevitably fail even if there is no underlying trend in price. Moreover, the historical tendency to intervene in the price system in a discretionary and less-than-transparent way undermines private sector planning and opens programmes to capture by vested interests.

The use of variable tariff instruments is also subject to similar criticism. While at face value they present scope to protect producers from extremely low prices in food-importing countries, they require very open and transparent rules that would preferably be monitored by the WTO to prevent abuse and political patronage. Unless the tariff is already high, variable tariffs do not address effects of price spikes on consumers, and because high tariffs on food grains can cause both inefficiency and higher inequality (the poor are penalized), they are not usually a desirable option: it is clear that variable tariffs are of limited value for protecting against price spikes, a goal that is often the main concern of food-importing countries (World Bank, 2005). In addition, for those schemes that are in place, such as in Chile, comprehensive welfare analyses to establish the economic costs and gains have not been forthcoming.

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